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SOME FEATURES OF IMFORTANT TAXA OF SOIL MESOFAUNA IN AN AFRO-MEDITERRANEAN COASTAL DESERT.

II.—SOIL MESOFAUNA IN IRRIGATED VINEYARDS.

Bv

SAMIR I. GHABBOUR and SAFWAT H. SHAKIR

Dept. of Natural Resources, Institute of African Research and Studies, Cairo University, Giza, Cairo, Egypt

INTRODUCTION

This paper is the second part of a survey of populations of soil mesofauna in agro-ecosystems of the Mariut Region, west of Alexandria. Earlier, we dealt with dry-farmed agro-ecosystems of tree crops : almond, and fig, (GHABBOUR and SHAKIR 1982 a aud b.). In this paper, we shall deal with populations in irrigated vineyards recently established by the government-sponsored land reclamation efforts in the area of Gharbaniat village, 53 km west of Alexandria. The Mariut Region was a region of extensive vine cultivation in Graeco-Roman times by elaborate water harvesting techniques, but this seems to have ceased and the techniques forgotten, and the practices abandoned since the 10th century, when the Region was occupied by pastoral Bedouins whose main source of living was husbandry of sheep and goats (KASSAS 1972 and 1979). However, SOLTAN (1979) records the presence of isolated individuals of a vine variety called "roumi" by the Bedouins, growing in a feral state in some non-irrigated Bedouin orchards. It has red berries and is highly drought resistant. It is believed that these isolated bushes may be remnants of the variety of vine that was grown by dry-farming in Graeco-Roman times.

Land reclanmation projects in the Mariut Region were started since 1960, based on excess Nile water provided by storage in the Aswan High Dam Lake. The Bahig Canal brings this water as far as Hammam,

about 70 km west of Alexandria. Irrigation water is used to maintain rotations of annual field crops (clover/maize), or some tree crops (vines *Vitis vinifera,* or pears, etc.). Before the definitive crop is planted, the reclaimed land undergoes a few years of cultivation with alfalfa (*Medicago sativa*) to improve soil quality. In 1965, the irrigated area was estimated at 10,000 feddans (1 fed. = 0.42 ha), but there were plans to irrigate a further 18,000 fed. south of the Mariut Salt Marsh (UNDP/FAO 1971, AYYAD and GHABBOUR 1977). At present, the area of vineyards south of Lake Mariut may reach 10,000 fed. In this paper we shall deal with two adjacent farms which started production and were established in the 1970's.

I.—MATERIAL and METHODS

A) The sites :

Two vineyards of different age were chosen for this study, one older (old vineyard, OV), and the other younger (young vineyard, YV), in the same area of reclaimed desert land south of Gharbaniat village, in the Mariut frontal plain (see map given by GHABBOUR and SHAKIR 1982 a). The area had a wild vegatation cover dominated by *Thymelaea* still existing south of the vineyards, and whose populations of soil mesofauna were investigated earlier (GHABBOUR and SHAKIR 1980). The area of OV (Plate I) is about 160 ha and is cultivated since 1971, thus being 6—7 years old at time of sampling. The distances between shrubs are 2.5 x 1.8 m, so that density is about 2340/ha. The area of YV is about 126 ha and cultivated since 1974, thus being 3—4 years old at time of sampling. The distances between shrubs are 2.5 x 2 m, so density is about 2100/ha. The soils of these two farms (lying within the same formation) are similar to a great extent, except that the surface soil has a slightly higher clay content, and deeper layers have a higher gravel content, in YV. GOMAA et al. (1978) described the soil of OV and gave the following characteristics :

slope — almost flat,

parent material — calcareous marine deposits,

horizon, depth and description —

Plate I.—Genereral view of the irrigated "old" vineyard at Gharbaniat (south), between the third and fourth ridges, in areclaimed desert land originally occupied by a *Thymelaea*-dominated association, and irragetd by Nile water. Note the tall **Casuarina** windbreak allowing for a somewehat mesic micro-climate.

A_1	0—10 cm	dull yellow orange, sandy loam, slightly sticky and slightly plastic in wet, friable in moist, soft in dry, crumb structure, abundant medium roots, diffuse and smooth boundary, coarse sand 22%, medium sand 18%, fine sand 12%, silt 21%, clay 24%,
A_2	10—25	bright yellowish brown, loamy, sticky and plastic in wet, firm in moist, slightly hard in dry, crumb structure, common fine roots, diffuse and smooth boundary, coarse sand 24%, medium sand 12%, fine sand 20%, silt 18%, clay 25%,
A_3	25—40	yellowish brown, loamy sand, slightly sticky and slightly plastic in wet, firm in moist, soft in dry, massive structure, few very fine roots, gradual and smooth

		boundary, coarse sand 18%, medium sand 15%, fine sand 17%, silt 20%, clay 31%.
AB	40—55	bright yellowish brown, loamy sandy, slightly sticky and slightly plastic in wet, firm in moist, slightly hard in dry, massive structure, slight evidence for secondary carbonate accumulation, very few, very fine roots, gradual and irregular boundary, coarse sand 17%, medium sand 21%, fine sand 20%, silt 14%, clay 28%,
Aca	55—100	bright yellowish brown, sandy loam, slightly sticky and slightly plastic in wet, firm in moist, slightly hard in dry, secondary carbonate accumulation, common calcareous concretions, coarse sand 19%, medium sand 28%, fine sand 14%, silt 15%, clay 23%.

The calendar of agricultural practices in these two vineyards is shown in Tab. 1. Irrigation is sometimes mode diffisult by the unavailability of water in the irrigation channels. SOLIMAN (1981) noted that lack of water is an important constraint on these irrigated farms, preventing full utilization of reclaimed lands, due to fluctuating discharges of pumping stations, seepage from unlined irrigation canals, and their inadequate maintenance. Accordingly, normal irrigation of vineyards at Gharbaniat does not follow the regime practiced in the neighbouring Beheira Province (cf. El-DUWEINI and GHABBOUR 1965), which is twice every month from late Jaunary to early August, that is, about 14 times. At the Gharbaniat vineyards. irrigation may be as few as 5 times only from March to July, once in each month. The rest of the orchard's water requirement may be partially compensated for by rainfall from October to February or March. The total water requirement must be adequately provided by increasing the amount of water at each application. Chemical fertilizers are varied : oragnic manure is applied at the rate of 10—20 m3/fed. (25—50/ha) and 100 kgm/fed. superphosphate. Both in January and in March either ammonium nitrate or ammonium sulfate is applied at the rate of 150 kgm/fep.,

Tab. I

Phenology of vines, calendar of agricultural practices, sampling dates, soil moisture %, and organic matter % (at 5 cm depth), at the two adjacent vineyards irrigated in the Mariut frontal plain, between the third and fourth ridges, at Gharbaniat village, in the Mariut Region 53 km west of Alexandria. The "old" vineyard (OV) was 6—7 years old at time of sampling, while the "young" one)YV) was 3—4 years old.

Month	1	2	3	4	5	6	7	8	9	10	11	11
Season	W	W	W	Sp	Sp	Su	Su	Su	Su	A	A	W
Phend.	D Lf	D Lf	Lf	Lf Fl	Lf Fr	Lf Fr	Lf Fr	Lf Fr	Lt D	D	D	D
Irrign			×	×	×	×	×					
Pruning	×	×									×	×
Tillage		×		×		×						
Fertil.	×		×			×						
Pastic.				×								
OV s				15.78		24.77	13.78			28.78		10.77
OVSM%5				23.51		19.18	3.77			12.51		13.28
OVSM%3				19.03		19.51	8.77			12.87		13.65
OVSM%6				17.95		18.22	9.54			13.02		12.91
OVOM%				1.20		0.81	0.93			1.11		0.87
YV s.			31.78		28.78		7.77	31.78			23.78	
YVSM%			4.78		4.23		12.56	2.43			6.55	
YVSM%3			11.26		9.55		17.07	8.70			7.77	
YVSM%6			12.98		13.26		18.06	11.00			10.78	
YVOM%			0.73		0.94		0.65	0.91			0.78	

Abbreviations : Months, 1—12, Jan.—Dec., W, winter, Sp, spring, Su, summer, A, autumn; D, dormant, Lf, leafing out, Fl, flowering, Fr, fruiting, Lt, litter fall; OV s., sampling dates of old vineyard showing day and year, OVSM%5, soil moistures % at 5 cm depth in OV, OVSM %3, eame at 30 cm depth, OVSM %6, same at 60 cm depth OVSM %, soil organic mater % at 5 cm depth; YV s·—YVOM %, as for OV, but for "young" vineyard.

The annual averages for each of the above variables of moisture and organic matter are: OVSM%5‘ 14.45, OVSM%3, 14.77, OVSM%6, 14.33, OVOM %, 0.98, YVSM %5, 6.11, YVSM %3‘ 10.87, YVSM %6, 13.22, YVOM%‘ 0.80.

and potassium sulfate is applied in June at the rate of 50 kgm/fed. Pesticides are applied in April to control mole-crickets and some other insects, as well as fungi.

B) Sampling and extraction of soil mesofaunae :

The soils of the two vineyards are massive and consolidated, and could not pass through a sieve, so that the hand-picking method had to be used in both. The two farms were sampled in summer 1977, and in all four seasons of 1978, so that they overlap in all five seasons and sampling was duplicated in summer 1977 and in summer 1978 for both farms. In every farm and in every season (except where indicated), 10 quardrats of $50 \times 50 \times 60$ cm were laid along a line selected at random (a transect), within the center of the farm. The rest of the procedure for extraction and treatment of data was described earlier (GHABBOUR and SHAKIR 1980 and 1982 a)

According to the concept of degree of artificialization proposed by LONG (1979) and LE FLOC'H (1981), the two vineyards will obtain a value of 7/2 (irrigated agriculture, vineyards), but parhaps the young vineyard (YV), may take 7/2/1, and the old vineyard (OV), take 7/2/2, having received more human effort and management, being older.

II.—RESULTS

Tab. I gives results of soil moisture and soil organic matter analyses for the two vineyards. It is evident that the old vineyard (OV) has higher moisture of an average 14—15% at all depths. The lowest values were in July 1978 (3.8% at the surface), confirming the difficulty of obtaining irrigation water in summer. The highest value was recorded in April 1978 (24% at surface), but the range at 30 cm was 8.8—19.5%, and at 60 cm, 9.5—18.2%, with high values in July 1977, indicating adequate water supplies in that year. In the young vineyard (YV), the lowest values were also in Aug.—Nov. 1978 and the highest in July 1977. The range of moisture at the surface was 2.4—12.6%, at 30 cm 7.8—17.1%, and at 60 cm 10.8—18.1%. Organic matter was not particularly high, as might be expected in reclaimed desert soils. In OV it ranged from 0.8 to 1.1%, with an annual average of 1.0%, in the YV the range was 0.7—0.9%, with an annual average of 0.8%.

Tabs. II—V and Figs. 1—4 show the seasonal fluctuations in population density (PD) and biomass (BM) of soil mesofauna in the two vineyards. Persistent taxa in OV were: Isopoda, spiders and Formicidae. Taxa that appeared in four seasons out of five were : earthworms only. Taxa that appeared in only one season were : Phymatidae and Tenebrionidae. Howver, larvae of Tenebrionidae, as well as those of Scarabaeidae and Carabidae appeared with adults in the same or in a different season, indicating that these taxa are autochthonous and not in–migrants, but they may be nevertheless of low importance. In YV, persistent taxa were only spiders. Taxa appearing in four seasons were : Isopoda and Formicidae. Taxa appearing in one season only were : Mantidae, Blattidae, Pyrrhocoridae, Phymatidae, Diptera (adults), Eurytomidae and Scarabaeidae (larvae).

When arranged in descending order according to the annual PD average, the dominant and sub–dominant taxa may be arranged in this order :

OV		YV	
Earthworms	62.7%	Formicidae	77.7%
Formicidae	21.2%	Isopoda	6.6%
Spiders	4.2%	Earthworms	3.9%
Carabidae (ad.)	2.3%	Spiders	3.8%
Pyrrhocoridae	2.1%	Gryllotalpidae	2.6%
Isopoda	1.6%	Carabidae (ad.)	1.2%
Lepidoptera (p.)	1.2%	Tenebrionidae (ad.)	0.9%

In the case of BM, the seven dominant and sub–dominant taxa are arranged in the following order :

OV		YV	
Earthworms	80.0%	Gryllotalpidae	49.4%
Gryllotalpidae	7.2%	Tenebrionidae (a.)	14.0%
Lepidoptera (l.)	3.1%	Tenebrionidae (l.)	11.4%
Scarabaeidae (l.)	2.6%	Formicidae (a.)	10.8%
Spiders	1.0%	Earthworms	5.1%
Carabidae (a.)	0.7%	Lepidoptera (l.)	4.2%
Pyrrhocoridae	0.7%	Isopoda	2.2%

Tab. II Seasonal variation of population density per/m2 and percentage of total of soil mesofaunal taxa, Old vine–South Gharbaniat.

Taxa fo soil mesofauna	Summer 1977		Winter 1978		Spring 1978		Summer 1978		Autamn 1978		Annua	
	PD	%	PD	%	PD	%	PD	%	PD		PD	%
Earthworms	0.40	6.67	7.60	27.14	104.50	93.72	—	—	30.67	75.41	28.63	62.74
Non–insect arthropods	1.20	20.00	6.80	24.29	2.00	1.80	2.00	4.76	1.34	3.30	2.66	5.83
Isopod	0.40	6.67	0.80	2.86	1.00	0.90	0.80	1.90	0.67	1.65	0.73	1.60
Spiders	0.80	13.33	6.00	21.43	1.00	0.90	1.20	2.86	0.67	1.65	1.93	4.23
Insecta	4.40	73.33	13.60	48.57	5.00	4.48	40.00	95.24	8.66	21.29	14.34	31.43
Orthoptera	—	—	1.60	5.71	—	—	—	—	0.67	1.65	0.45	0.99
Gryllotalpidae	—	—	1.60	5.71	—	—	—	—	0.67	1.65	0.45	0.99
Hemiptera	1.20	20.00	2.80	10.00	—	—	1.20	2.86	1.33	3.27	1.31	2.87
Pyrrhocoridae	0.80	13.33	2.80	10.00	—	—	1.20	2.86	—	—	0.96	2.10
Anthocoridae	0.40	6.67	—	—	—	—	—	—	0.67	1.65	0.21	0.46
Phymatidae	—	—	—	—	—	—	—	—	0.67	1.65	0.13	0.28
Lepidoptera	—	—	—	—	—	—	0.40	0.95	4.00	9.84	0.88	1.93
(L)*	—	—	—	—	—	—	0.40	0.95	1.33	3.27	0.35	0.77
(P)	—	—	—	—	—	—	—	—	2.67	6.57	0.53	1.16
Hymenoptera	0.40	6.67	8.80	31.43	1.50	1.35	36.40	86.67	1.33	3.27	9.69	21.24
Formicidae (A)	0.40	6.67	8.80	31.43	1.50	1.35	36.40	86.67	1.33	3.27	9.69	21.24
Coleoptera	2.80	46.68	0.40	1.43	3.50	3.14	2.00	4.76	1.33	3.27	2.00	4.38
Tenebrionidae (A)	—	—	—	—	—	—	0.80	1.90	—	—	0.16	0.35
(L)	—	—	—	—	—	—	0.40	0.95	—	—	0.08	0.18
Scarabaeidae (A)	—	—	0.40	1.43	—	—	—	—	—	—	0.08	0.18
(L)	—	—	—	—	—	—	0.40	0.95	—	—	0.08	0.18
Carabidae (A)	0.40	6.67	—	—	3.50	3.14	—	—	1.33	3.27	1.05	2.30
(L)	0.40	6.67	—	—	—	—	—	—	—	—	0.08	0.18
Staphylinidae (A)	1.60	26.67	—	—	—	—	0.40	0.95	—	—	0.40	0.88
Indet	0.40	6.67	—	—	—	—	—	—	—	—	0.08	0.18
Total	6.00	100	28.00	100	111.50	100	42.00	100	40.67	100	45.63	100
Standerd error	2.48	—	8.20	—	62.97	—	31.40	—	10.60	—	17.68	—

* L = larvae P = pupae A = adults. Perentages do not always add up to 100 because of rounding off. Only autumn 1978 data in the line for "Gryllotalpidae" (in italics) belong to Gryllidae. See text for further details.

Tab. III Seasonal variation of biomass (BM) per m2 and percentage of total biomass of soil mesofaunal taxa-Old vine-South Gharbaniat.

Taxa of soil mesofauna	Summer 1977		Winter 1978		Spring 1978		Summer 1978		Autumn 1978		Annual	
	BM	%	BM	%	BM	%	BM	M	BM	%	BM	%
Earthworms	1.20	2.02	283.20	31.33	3866.00	98.62	—	—	180.60	82.19	1191.28	80.04
Non-insect arthropods	7.60	12.78	46.40	5.13	37.00	0.94	23.40	6.47	6.66	0.30	24.22	1.63
Isopoda	2.40	4.00	4.00	0.44	33.00	0.84	3.60	0.99	5.33	0.24	9.67	0.65
Spiders	5.20	8.78	42.40	4.69	4.00	0.10	19.80	5.48	1.33	0.06	14.55	0.98
Insecta	50.40	85.20	574.40	63.54	17.50	0.44	337.60	93.53	384.67	17.51	272.81	18.33
Orthoptera	—	—	536.40	59.34	—	—	—	—	2.00	0.09	107.68	7.24
Gryllotalpidae	—	—	536.40	59.34	—	—	—	—	2.00	0.09	107.68	7.24
Hemiptera	6.40	10.81	32.00	3.54	—	—	12.40	3.43	4.67	0.21	11.09	0.75
Pyrrhocoridae	5.60	9.46	32.00	3.54	—	—	12.41	3.43	—	—	10.00	0.67
Anthocoridae	0.80	1.35	—	—	—	—	—	—	2.00	0.09	0.56	0.04
Phymatidae	—	—	—	—	—	—	—	—	2.67	0.12	0.53	0.04
Lepidioptera	—	—	—	—	—	—	90.00	24.93	370.00	16.84	92.00	6.18
(L)*	—	—	—	—	—	—	90.00	24.93	141.33	6.43	46.27	3.11
(P)	—	—	—	—	—	—	—	—	228.67	10.41	45.73	3.07
Hymenoptera	0.40	0.68	5.20	0.58	1.00	0.03	22.00	6.10	1.33	0.06	5.99	00.04
Formicidae (A)	0.40	0.68	5.20	0.58	1.00	0.03	22.00	6.10	1.33	0.06	5.99	0.40
Coleoptera	43.60	73.65	0.80	0.09	16.50	0.42	213.20	59.06	6.67	0.30	56.15	3.77
Tenebrionidae (A)	—	—	—	—	—	—	0.80	0.22	—	—	0.16	0.01
(L)	—	—	—	—	—	—	14.80	4.10	—	—	2.96	0.21
Scarabaeidae (A)	—	—	0.80	0.09	—	—	—	—	—	—	0.16	0.01
(L)	—	—	—	—	—	—	196.80	54.52	—	—	39.36	2.64
Carabidae (A)	27.20	45.95	—	—	16.50	0.42	—	—	6.67	0.30	10.07	0.68
(L)	0.40	0.68	—	—	—	—	—	—	—	—	0.08	0.01
Staphylinidae (A)	14.80	25.00	—	—	—	—	0.80	0.22	—	—	3.12	0.21
Indet.	1.20	2.02	—	—	—	—	—	—	—	—	0.24	0.02
Total	59.20	100	904.00	100	3920.50	100	361.00	100	2197.33	100	1488.31	100
Standerd error	28.13	—	335.79	—	883.75	—	201.73	—	757.77	—	709.59	—

* See Tab. II.

Tab. IV Sesasonal variation of population density (PD) per m^2 and percentage of total of soil mesofaunal taxa-young vine—South Gharbaniat.

Taxa of soil mesofauna		Summer 1977		Winter 1978		Spring 1978		Summer 1978		Autumn 1978		Annual	
		PD	%	PD	%	PD	%	PD	%	PD	%	PD	%
Earthworms		9.20	79.31	—	—	—	—	0.80	5.71	—	—	2.00	3.87
Non-insect arthropods		0.40	3.45	13.00	41.94	8.00	4.07	2.80	20.00	2.40	46.15	5.32	10.31
Isopoda		—	—	8.50	27.42	7.27	3.70	0.40	2.86	0.80	15.38	3.39	6.57
Spiders		0.40	3.45	4.50	14.52	0.73	0.37	2.40	17.14	1.60	30.77	1.93	3.74
Insecta		2.00	17.24	18.00	58.06	188.36	95.93	10.40	74.29	2.80	53.85	44.31	85.82
Orthoptera		0.80	6.90	6.00	19.35	—	—	—	—	0.80	15.38	1.52	2.94
Mantidae		—	—	—	—	—	—	—	—	0.40	7.69	0.08	0.15
Gryllotalpidae		0.80	6.90	6.00	19.35	—	—	—	—	0.40	7.69	1.44	2.79
Dictyoptera		—	—	—	—	0.36	0.18	—	—	—	—	0.07	0.14
Blattidae		—	—	—	—	0.36	0.18	—	—	—	—	0.07	0.14
Hemiptera		0.40	3.45	—	—	0.36	0.18	0.80	5.71	—	—	0.31	0.60
Pyrrhocoridae		—	—	—	—	—	—	0.40	2.86	—	—	0.08	0.15
Pentatomidae		0.40	3.45	—	—	—	—	0.40	2.86	—	—	0.16	0.31
Phymatidae		—	—	—	—	0.36	0.18	—	—	—	—	0.07	0.14
Lepidoptera	(L)*	—	—	0.50	1.61	1.82	0.93	—	—	—	—	0.46	0.89
Diptera	(A)	0.40	3.45	—	—	—	—	—	—	—	—	0.08	0.15
Hymenoptera		—	—	10.00	32.26	184.36	93.89	6.00	42.86	0.80	15.38	40.23	77.92
Formicidae	(A)	—	—	9.50	30.65	184.36	93.89	6.00	42.86	0.80	15.38	40.13	77.73
Eurytomidae	(A)	—	—	0.50	1.61	—	—	—	—	—	—	0.10	0.19
Coleoptera		0.40	3.45	1.50	4.84	1.55	0.74	3.60	25.71	1.20	23.08	1.63	3.16
Tenebrionidae	(A)	—	—	—	—	—	—	1.60	11.43	0.80	15.38	0.48	0.93
	(L)	—	—	—	—	1.09	0.56	0.80	5.71	0.40	7.69	0.46	0.89
Scarabaeidae	(L)	—	—	—	—	0.36	0.18	—	—	—	—	0.07	0.14
Carabidae	(A)	0.40	3.45	1.50	4.84	—	—	1.20	8.57	—	—	0.62	1.20
Total		11.60	100	31.00	100	196.3	100	14.00	100	5.20	100	51.63	100
Standard error		6.99	—	7.51	—	175.67	—	4.00	—	1.58	—	36.43	

* See Tab. II.

Tab. V Seasonal variation of biomass (BM) per m^2 and percentage of total biomass of soil mesofauna taxa, Young vine-South Gharbaniat.

Taxa of soil mesofauna	Summer 1977		Winter 1978		Spring 1978		Summer 1978		Autumn 1978		Annual	
	BM	%	BM	%	BM	%	BM	%	BM	%	BM	%
Earthworms	278.00	53.05	—	—	—	—	94.00	6.94	—	—	74.40	5.08
Non insect arthropods												
Isopoda	—	—	106.00	2.77	43.64	4.00	1.60	0.12	8.80	1.64	32.01	2.18
Spiders	4.40	0.84	15.75	0.41	3.27	0.30	13.60	1.00	4.80	0.89	8.36	0.57
Insecta												
Orthopotera	212.00	40.46	3404.50	89.11	—	—	—	—	12.40	2.31	725.78	49.53
Mantidae	—	—	—	—	—	—	—	—	6.80	1.27	1.36	0.09
Gryllotalpidae	212.00	40.46	3404.50	89.11	—	—	—	—	5.60	1.04	724.42	49.43
Dictyoptera	—	—	—	—	78.55	7.20	—	—	—	—	15.71	1.07
Blattidae	—	—	—	—	78.55	7.20	—	—	—	—	15.71	1.07
Hemiptera	5.60	1.07	—	—	1.45	0.13	12.80	0.94	—	—	3.97	0.27
Pyrrhocoridae	—	—	—	—	—	—	5.60	0.41	—	—	1.12	0.08
Pentatomidae	5.60	1.07	—	—	—	—	7.20	0.53	—	—	1.44	0.10
Phymatidae	—	—	—	—	1.45	0.13	—	—	—	—	0.29	0.02
Lepidoptera (L)§	—	—	174.00	4.55	133.82	12.27	—	—	—	—	61.56	4.20
Diptera (A)	22.00	4.20	—	—	—	—	—	—	—	—	4.40	0.30
Hymenoptera	—	—	92.00	2.41	683.64	62.67	17.00	1.25	1.20	0.22	158.77	10.83
Formicidae (A)	—	—	91.50	2.39	683.64	62.67	17.00	1.25	1.20	0.22	158.65	10.83
Eurytomidae (A)	—	—	0.50	0.01	—	—	—	—	—	—	0.10	0.01
Coleoptera	2.00	0.38	28.50	0.75	146.55	13.43	1216.00	89.74	509.60	94.93	380.53	25.97
Tenebrionidae (A)	—	—	—	—	—	—	670.40	49.48	356.00	66.32	205.28	14.01
(L)	—	—	—	—	138.55	12.70	544.80	40.21	153.60	28.61	167.39	11.42
Scarabaeidae (L)	—	—	—	—	8.00	0.73	—	—	—	—	1.60	0.11
Carabidae (A)	2.00	0.38	28.50	0.75	—	—	0.80	0.06	—	—	6.26	0.43
Total	524.00	100	3820.75	100	1090.91	100	1355.00	100	536.80	100	1465.49	100
Standard error	328.60	—	1983.60	—	679.23	—	808.41	—	380.88	—	610.27	—

§ See Table (II)

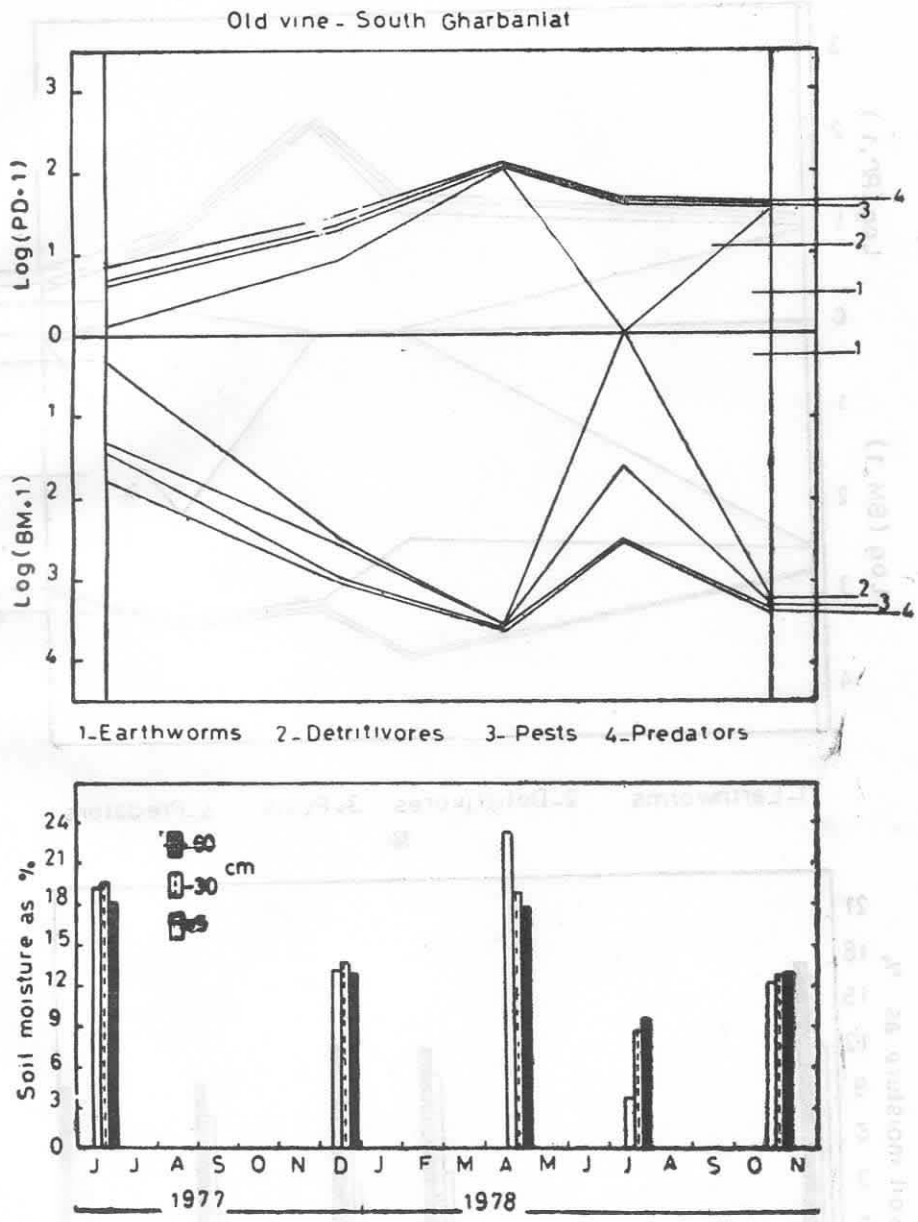


Fig. 1.— Seasonal variation in population density (PD) and biomass (BM), on a log scale, of detritivores, grazers (pests), and predators, among the mesofauna sampled in the "old" vineyard (OV). Earthworms are shown separately. Soil moisture content as % at 3 depths during the sampling period is also shown.

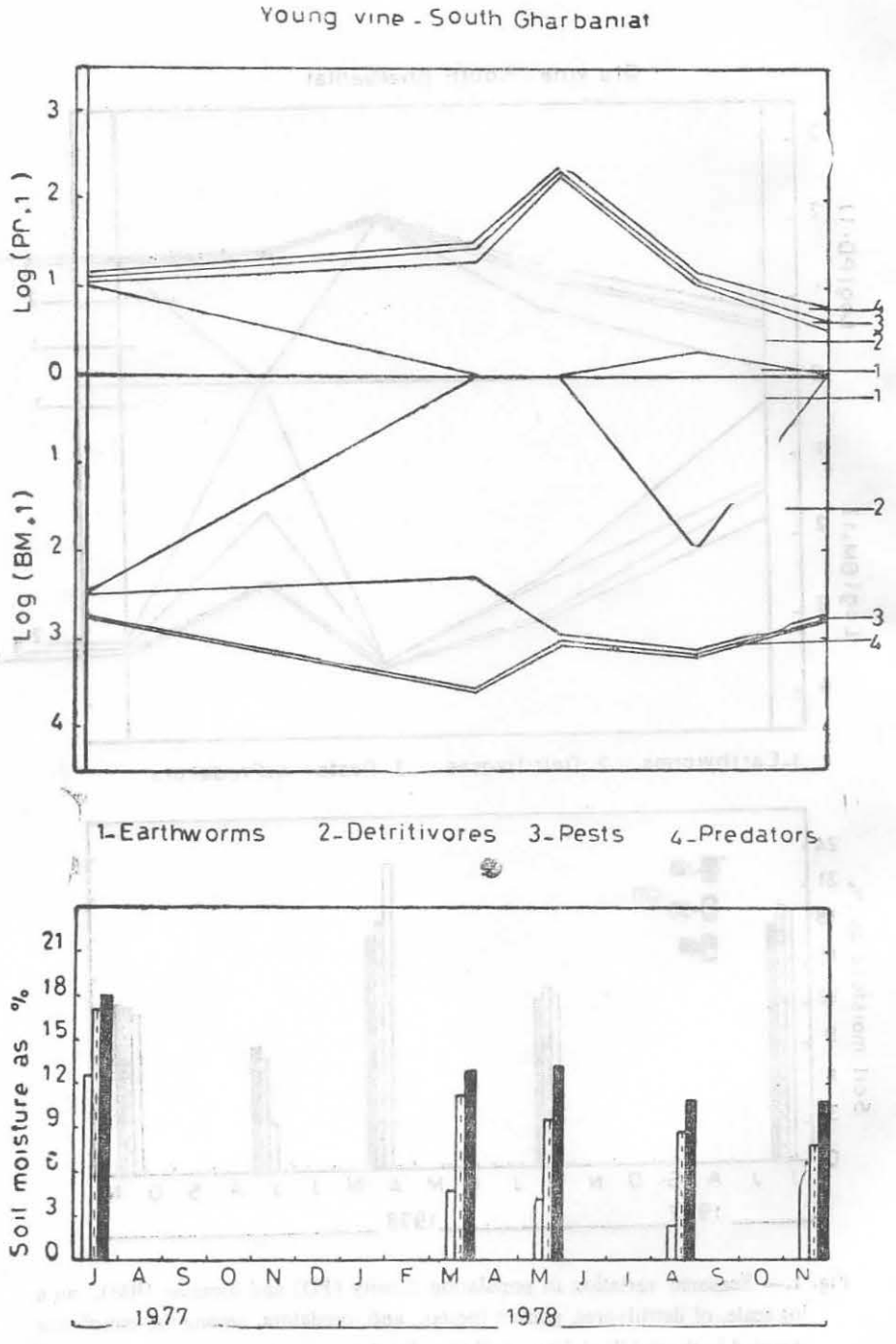


Fig. 2.—Same as in Fig. 1, for the "young" vineyard (YV). Earthworms are shown separately.

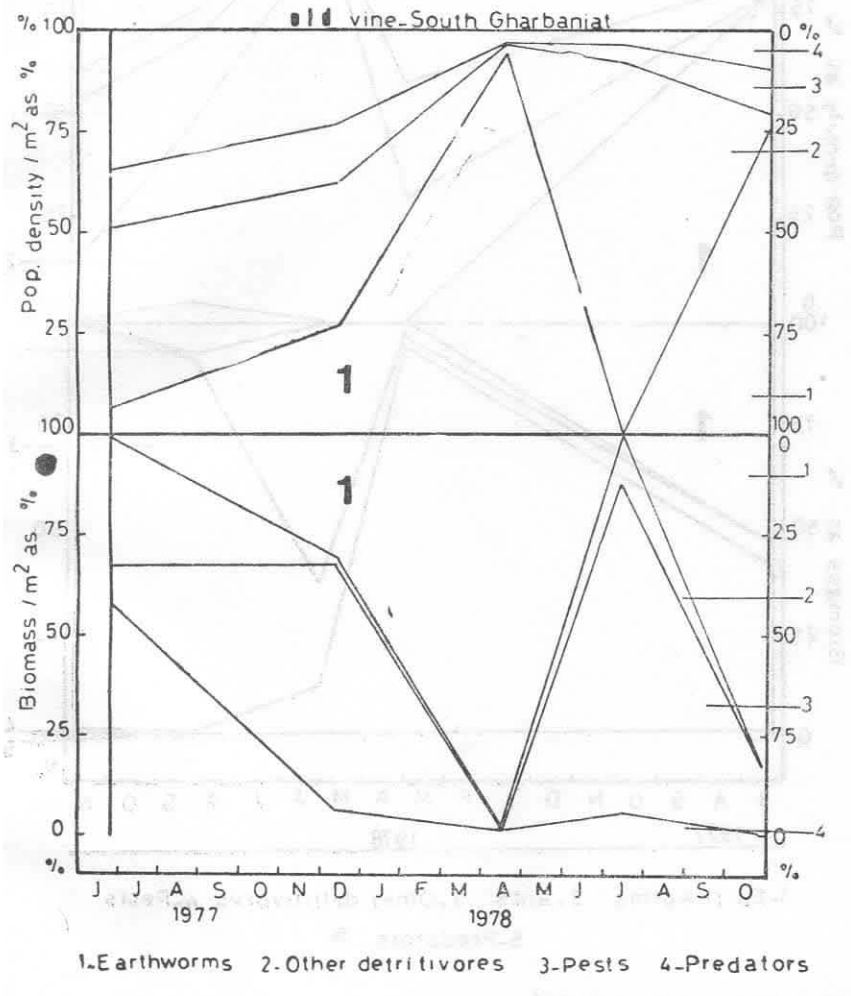
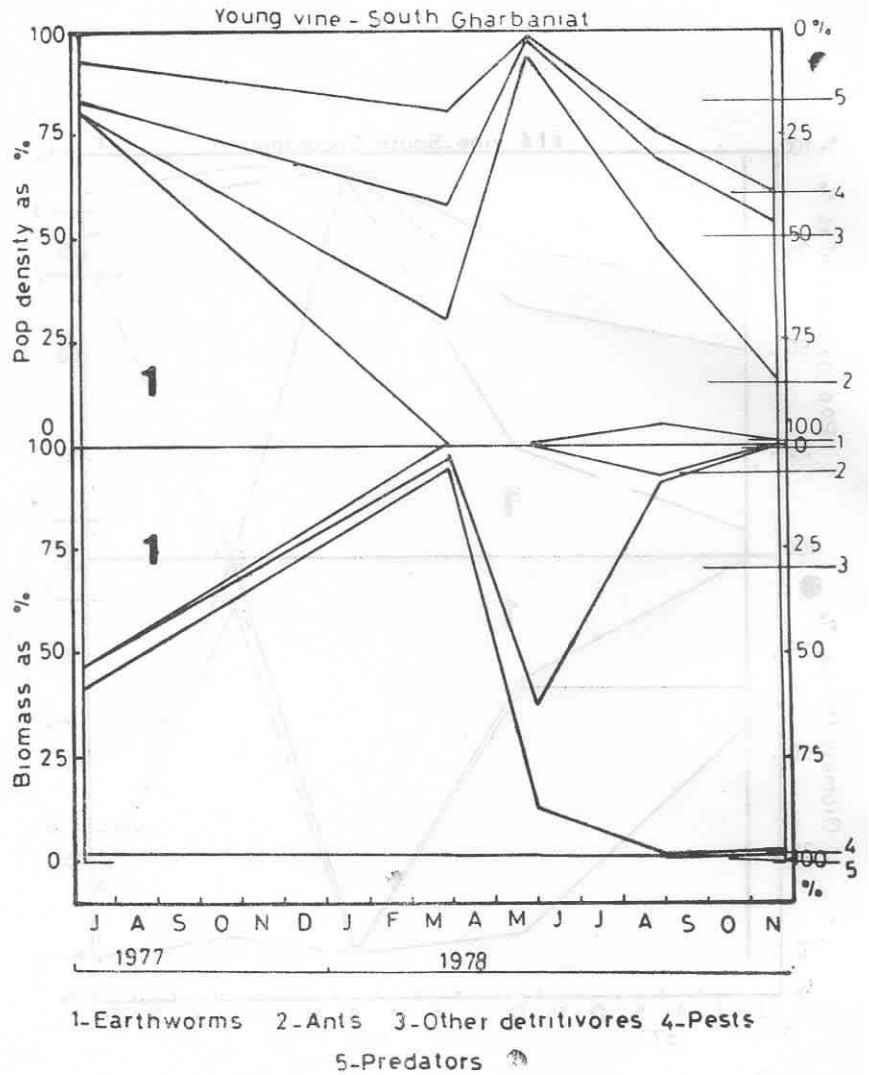


Fig. 3.—Seasonal variation of faunistic groups shown in Fig. 1, expressed as %.



.giF4.—Same as in Fig. 3, for YV.

Here we have the problem of grouping Lepidoptera pupae in the BM list. With larvae, they would constitute 6.2% of total BM in OV, and would very much approach Gryllotalpidae (the molecricket, *Gryllotalpa gryllotalpa*). But since a considerable portion of the weight of pupae is not true "biomass", they were excluded from the dominance list. Another problem in OV is the outstanding dominance of earthworm BM (*Allolobophora caliginosa* f. *trapezoides*, 80.0%), to such an extent that other taxa are dwarfed by comparison, and this places such usually important taxa as Carabidae, Pyrrhocoridae and Isopoda, in the background, with only 0.7% of the BM each. In YV, Tenebrionidae larvae and adults constitute together 25.4% of the BM, but the distribution is more equitable, with dominance of Gryllotalpidae, and recession of earthworms to 5.1% only of BM. It is evident that Formicidae are important in YV.

In order to resolve such differencess, application of A.I.V. and R.I.V (GHABBOUR and SHAKIR 1980), gives the following results (Figs 5 and 6):

	OV		YV	
	A.I.V.	R.I.V.	A.I.V.	R.I.V.
Earthworms	6.3	64.9	3.0	15.6
Isopoda	1.9	8.1	3.0	2.15
Spiders	2.9	17.4	2.8	24.8
Gryllotalpidae	2.3	10.5	4.0	57.7
Pyrrhotocoridae	2.1	9.2	-0.8	1.2
Lepidoptera (l.)	2.2	7.1	2.4	8.7
Formicidae (a.)	3.3	38.3	5.4	108.7
Tenebrionidae (a.)	-1.0	2.4	2.9	19.6
Tenebrionidae (l.)	-0.3	1.4	2.9	17.8
Scarabaeidae (l.)	0.8	3.8	-0.7	1.1
Carabidae (a.)	2.2	10.5	1.5	7.3

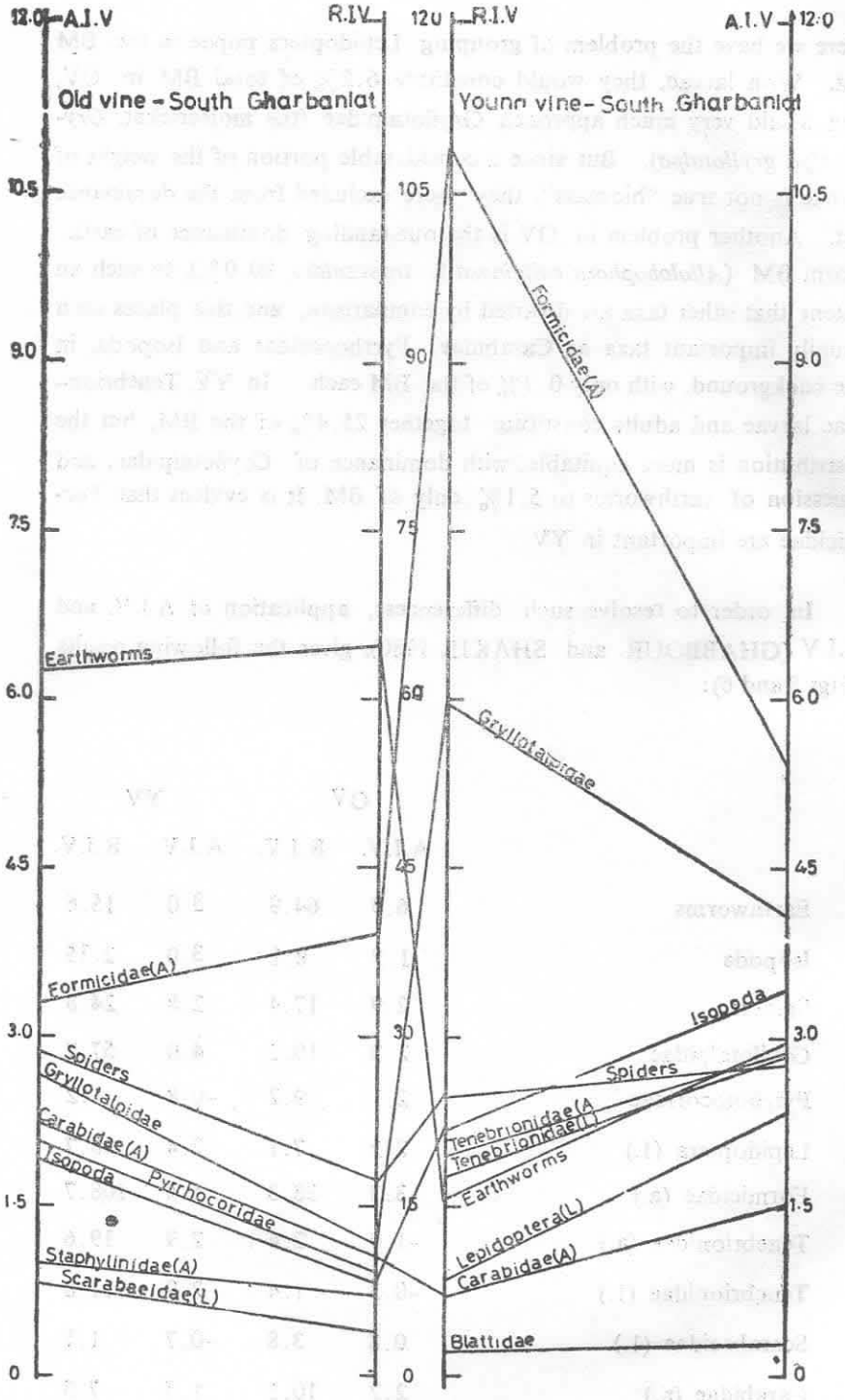


Fig. 5.—Position of taxa on the A.I.V. and R.I.V. scales, excluding those with A.I.V. less than O, at OV and YV.

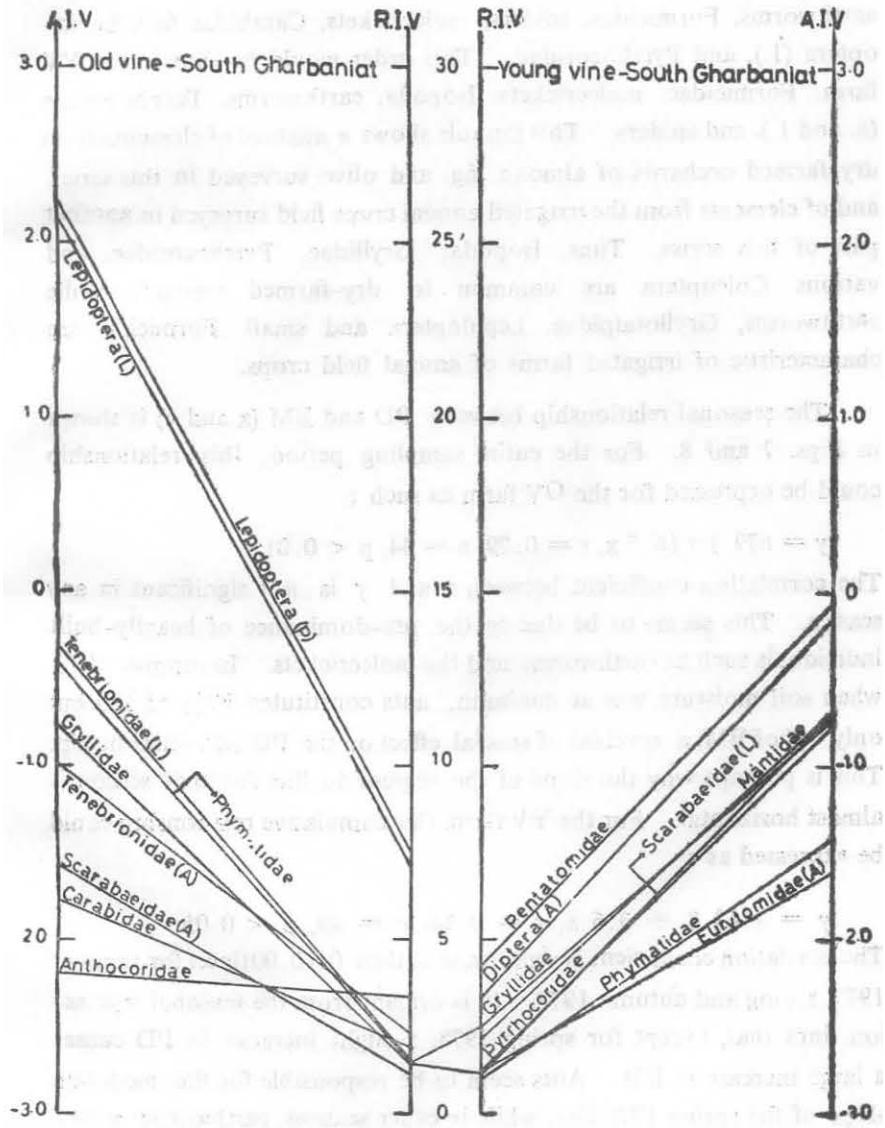


Fig. 6—Position of taxa with an A.I.V. less than O, on the A.I.V. and R.I.V. scales, for both vineyards.

Thus the order of the seven most important taxa on the A.I.V. and R.I.V. scales (which take into account the three population variables of PD, BM and frequency), would be of this order in the OV farm : earthworms, Formicidae, spiders, molecrickets, Carabidae (a.), Lepidoptera (l.), and Pyrrhocoridae. This order would be thus in the YV farm: Formicidae, molecrickets, Isopoda, earthworms, Tenebrionidae (a. and l.), and spiders. This faunule shows a mixture of elements from dry-farmed orchards of almond, fig, and olive surveyed in this series, and of elements from the irrigated annual crops field surveyed in another part of this series. Thus, Isopoda, Gryllidae, Pyrrhocoridae, and various Coleoptera are common to dry-farmed orchards, while earthworms, Gryllotalpidae, Lepidoptera and small Formicidae are characteristic of irrigated farms of annual field crops.

The seasonal relationship between PD and BM (x and y) is shown in Figs. 7 and 8. For the entire sampling period, this relationship could be expressed for the OV farm as such :

$y = 679.1 + 16.7\,x$, $r = 0.79$, $n = 44$, $p < 0.01$.

The correlation coefficient between x and y is not significant in any season. This seems to be due to the pre-dominance of heavily-built individuals such as earthworms and the molecrickets. In summer 1978, when soil moisture was at minimun, ants constituted 87% of PD but only 6% of BM, a reversal of special effect on the PD/BM relationship. This is perhaps why the slope of the regression line for that season is almost horizontal. For the YV farm, the cumulative relationship could be expressed as :

$y = 1163.8 + 3.6\,x$, $r = 0.34$, $n = 49$, $p < 0.05$.

The corrlation coeffi cient is significant at the 0.01-0.001 level for summer 1977, spring and autumn 1978. It is evident from the seasonal regression lines that, except for spring 1978, a slight increase in PD causes a large increase in BM. Ants seem to be responsible for the moderate slope of the spring 1978 line, while in other seasons, earthworms, molecrickets and Tenebrionidae (a. and l.), appeared in large numbers. On the whole, both vineyards had similar densities and similar biomass of soil mesofauna, although YV soil was less moist than OV soil by about 30%. The structure of the fauna confirms the idea of "backbone' taxa persisting in unfavourable seasons.

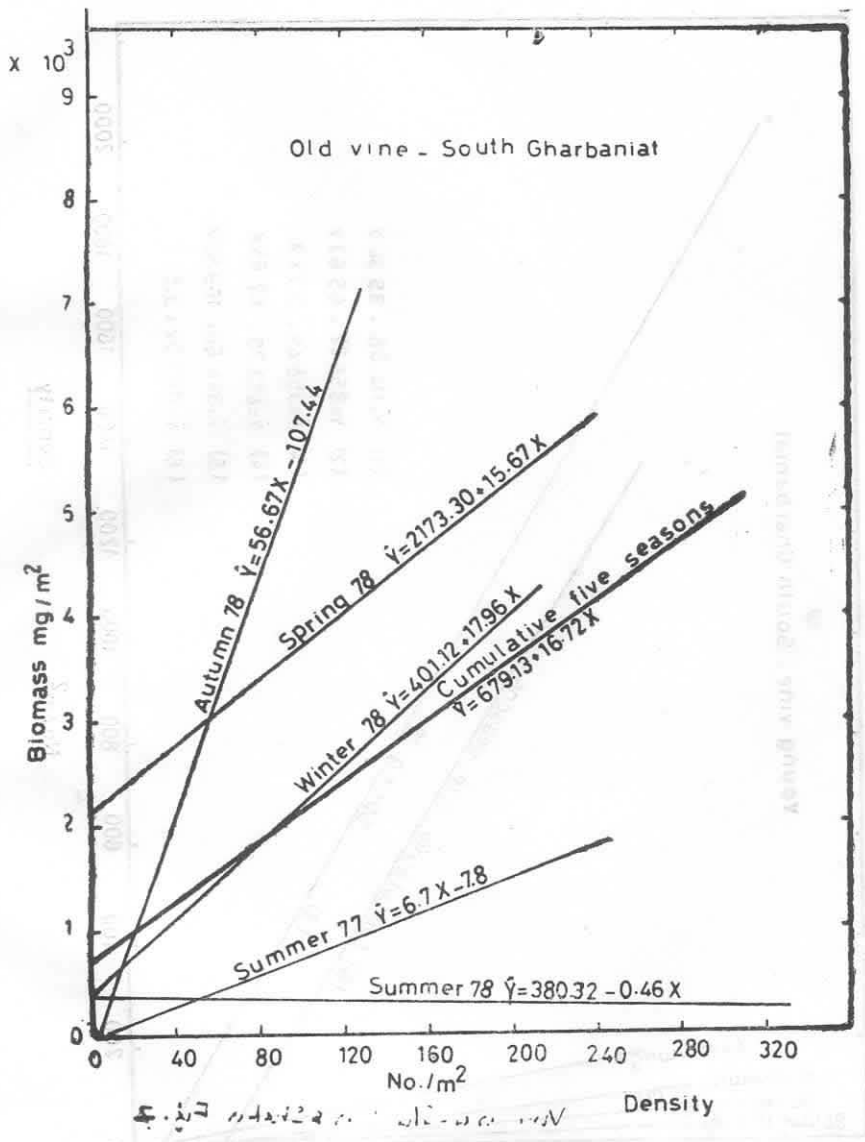


Fig. 7.—Regression lines for PD and BM of soil mesofaune in different seasons, for OV.

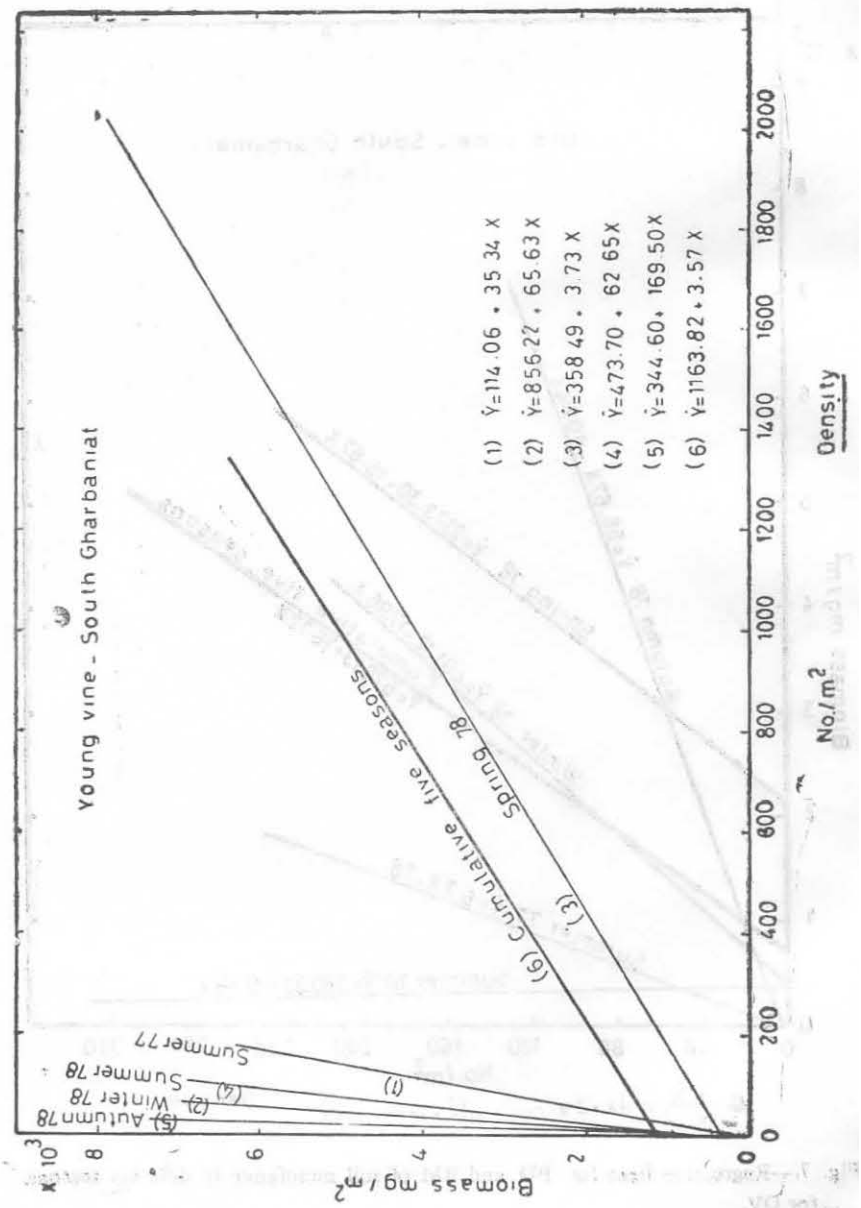


Fig. 8.—Same as in Fig. 7, for YV.

The breakdown of the fauna into functional groups, based on the annual averages, shows the following patterns :

	OV		YV	
	PD/m2	BM, mgm/m2	PD/m2	BM,mgm/m^2
Detritivores	39.9	1213.6	46.6	657.6
Grazers (pests)	2.4	249.0	2.3	791.4
Predators	3.4	25.8	2.7	116.3
(as %)	8.0	1.8	5.5	8.0

Thus predators are of a relatively low percentage, as regards PD and BM, in both vineyards, but are more numerous and much lighter in the OV than in YV. The high BM of grazers (pests) in YV is noteworthy. Apparently, because they are mostly mole-crickets, no suitable predators were present to exploit their high BM.

III.—DISCUSSION

The overall seasonal occurrence of taxa in the two vineyards may seem to be similar. To start with, both are very much similar in soil characteristics, are under the same tree crop, and undergo similar intensive agricultural practices. The similarity of these three factors contributed to the appearance of similar taxa, although at enormously different PD and BM. A dense weedy cover develops in vineyards in winter, in the rainy season, and during the dormancy period of vine shrubs. This allows for the presence of Isopoda, Lepidoptera, and Gryllidae. Differences in PD and BM of taxa are shown on a log scale in Fig. 9. Gryllotalpidae are more important in YV, accompanied by a lesser importance of their palatable prey, the earthworms. In this sense, the mole-crickets represent an omnivorous taxon, acting both as a grazer (pest) and a predator. If considered a predator, the percentage of predators in YV will certainly become much higher than 5.5 (PD) or 8.0 (BM), as shown above. Formicidae are next in importance in YV. These are the three main burrowing taxa of soil mesofauna in the two vineyards. The sand roach, *Heterogamia syriaca,* common in the neighbouring *Thymelaea* desert, is totally absent. Isopoda, Gryllidae and Tenebriondae, also comon in the neighbourhood, are less important

in OV, perhaps due to greater artificialization of the habitat. Larvae of Scarabaeidae became more important in OV too, perhaps because of higher manure inputs.

The use of SORENSEN's and GLEASON's similarity coefficients between seasons (Tab. VI), based on A.I.V., shows that there are remarkably low similarities between seasons throughout the year in both vneyards. There is lower similarity for YV than for OV. For the latter, coefficients range from the lowest (spring 78/summer 78) to the highest (spring 78/summer 77, winter 78 and autumn 78). For the YV farm, coefficients range from the lowest (spring 78/summer 77) to the highest (winter 78/autumn 78, spring 78/winter 78). These very low similarities indicate a high seasonal turnover rate among taxa, and instability of the ecosystem, especially in the younger farm. The overall similarity between the two farms is 68—69%, which is rather high compared with the pairs of fig and olive orchards surveyed previously, as observed earlier. Again, this high similarity could be accounted for by contiguity of location, similarity of soil type, of original vegetation, of crop trees, and of agricultural practices. Tab. VII gives the order for application of the Index of Species Abundance (I.S.A.), according to the method proposed by ROBERTS and HSI (1979) The diversity indices based on R.I.V. are 0.82 (SIMPSON) and 0.81 (SHANNON–WIENER), and based on A.I.V. are 0.84 (S) and 0.90 (SW) for the OV farm. For the YV farm these figures are : 0.80, 0.80, 0.84, and 0.92, respectively, which are rather high.

IV.—CONCLUSIONS

In the previous studies on populations of soil mesofauna in a pair of dry-farmed fig orchards and a pair of dry-farmed olive orchards (GHABBOUR and SHAKIR 1982 b), certain features were pointed out as likely responsible for differences in the facies of these populations. For the two fig farms, these features were : soil structure, manure applications, and water balance. For the olive orchards, differences were in : slope, tree density, ground cover, and introduction

Tab. VI

Matrix of SORENSEN'S similarity coefficients between seasons (presence or absence of taxa, qualitative), in the lower left hand corner, and matrix of GLEASON's similarity coefficients between seasons (quantitative presence of taxa), in the upper right hand corner, using A.I.V.

(A) : **Old Vine-south Gharbaniat**

	Summer 77	Winter 78	Spring 78	Summer 78	Autumn 78
Summer 77		31	39	31	30
Winter 78	47		51	48	44
Spring 78	67	67		26	62
Summer 78	53	50	43		30
Autumn 78	60	47	67	42	

(B) : **Young vine-south Gharbaniat**

Summer 77		28	7	35	18
Winter 78	47		64	36	35
Spring 78	14	53		41	40
Summer 78	53	50	47		57
Autumn 78	31	57	40	62	

Tab. VII

Arrangment of taxa of soil mesofauna in the two irrigated vineyards at south Gharbaniat ("old", OV and "young", YV), according to the Index of Species Abundance (I.S.A.), proposed by ROBERTS and HSI (1979).

Serial no.	Taxon	OV	YV
1	Earthworms	1.0	3.0
2	Isopoda	6.0	2.0*
3	Spiders	3.0	4.0
4	Mantides	—	13.0
5	Gryllidae + Gryllotalpidae	8.0	5.0
6	Blattidae	—	16.0
7	Pyrrhocoridae	5.0	13.0
8	Anthocoridae	11.0	—
9	Pentatomidae	—	10.0
10	Phymatidae	13.0	16.0
11	Lepidoptera (l.)	10.0	8.5
12	Lepidoptera (p.)	7.0	—
13	Diptera (a.)	—	13.0
14	Formicidae	2.0	1.0
15	Eurytomidae	—	11.0
16	Tenebrionidae (a.)	12.0	7.0
17	Tenebrionidae (l.)	8.5	4.0
18	Scarabaeidae (a.)	16.0	—
19	Scarabaeidea (l.)	16.0	16.0
20	Carabidae (a.)	4.0	6.0
21	Carabidae (l.)	16.0	—
22	Staphylinidae (a.)	9.0	—

* Difference of PD significatnt at the p = 0.01—0.001 level. no significant differences for other taxa.

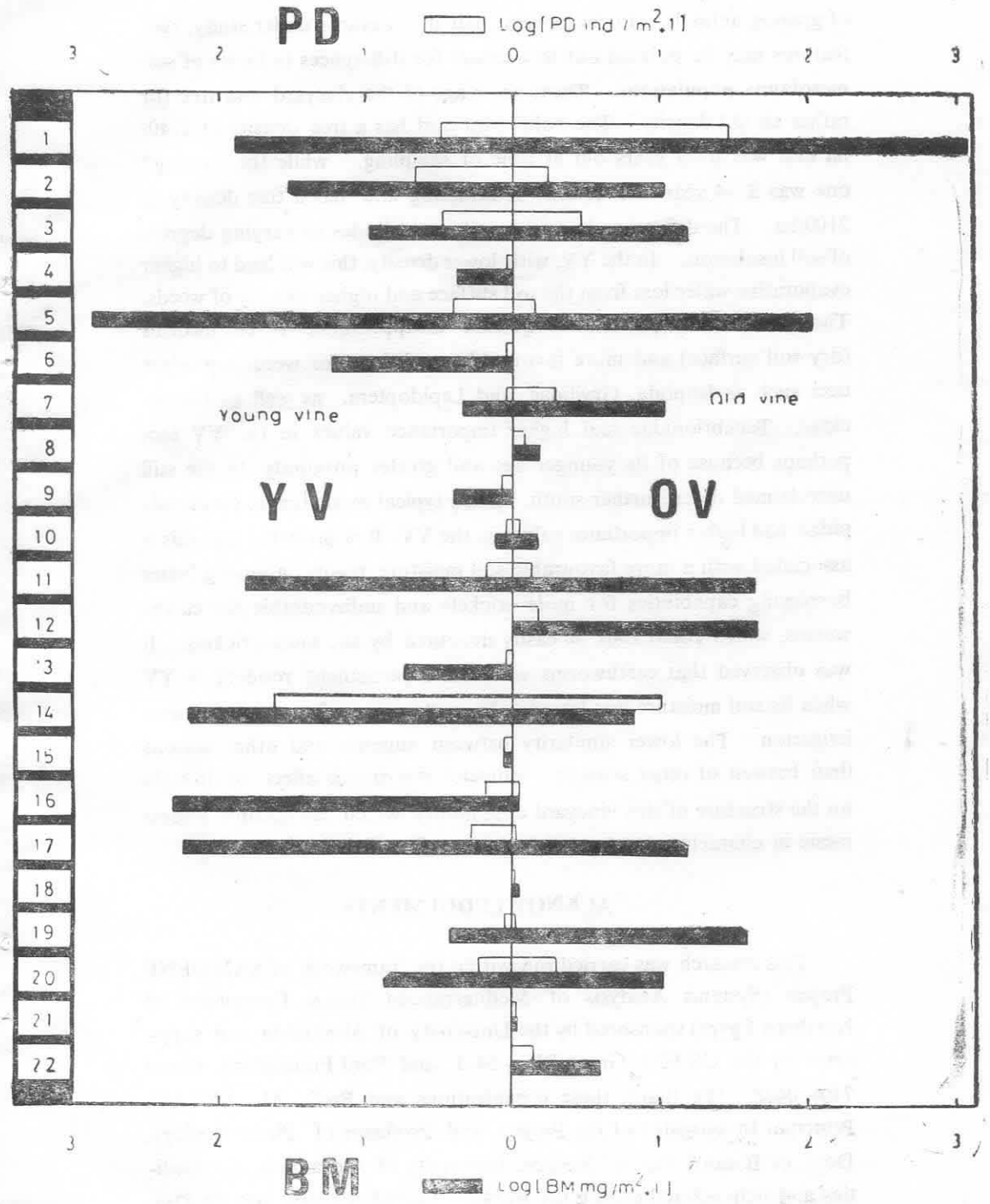


Fig. 9.—Comparison of PD (open bars) and BM (closed bars) of the 22 taxa appearing in the OV and YV farms, on a log scale. Arrangament of taxa is the in the order shown in Tab. VII. Gryllidae and Gryllotalpidae are considered together for convemience (no· 5).

of grazing animals. In the present pair of vineyards under study, two features may be pointed out to account for differences in facies of soil mesofauna populations. These are : age of the vineyard and tree (or rather shrub) density. The "old" vineyard has a tree density of 2240/ha and was 6—7 years old at time of sampling. while the "young" one was 3—4 years old at time of sampling and has a tree density of 2100/ha. The difference in tree density contributes to varying degrees of soil insolation. In the YV, with lower density, this will lead to higher evaporative water loss from the soil surface and higher density of weeds. These two effects will lead to quicker disappearance of earthworms (dry soil surface) and more favourable conditions for weed–dependent taxa such as Isopoda, Gryllidae, and Lepidoptera, as well as Formicidae. Tenebrionidae had higher importance values in the YV too, perhaps because of its younger age and greater proximity to the still unreclaimed desert further south. Yet, a typical mesic taxon, Gryllotalpidae, had higher importance values in the YV. It is probable that this is associated with a more favourable soil moisture regime, allowing better burrowing capabilities for mole–crickets and unfavourable for earthworms, which could thus be easily devoured by the mole–crickets. It was observed that earthworms were not a permanent resident in YV when its soil moisture was lowered by evaporation after the infrequent irrigation. The lower similarity between summer and other seasons than betwen of other seasons, indicates the drastic effect of drought on the structure of this vineyard community, which has become almost mesic in character, due to a high degree of artificialization.

ACKNOWLEDGEMENTS

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SUMMARY

A survey of populations of soil mesofauna in two irrigated vineyards south of Ghabaniat village, 53 km west of Alexandria, was carried out in 1977—1978. The two farms are situated in a depression of calcareous loamy soil. One was 6—7 years old at time of sampling with a tree density of 2340/ha (old vineyard, OV), and the other was 3—4 years old with 2100 trees/ha (young vineyard, YV). Population density in the OV farm varied from 6 to 112 /m2, with an annual average of 46/m2, and varied in the YV farm from 5 to 196/m2, with an annual average of 52/m2. Biomass of alcohol-presserved specimens varied in the OV farm from 59 to 3921 mgm/m2, with an annual average of 1488 mgm/m2, and varied in the YV farm from 524 to 3821 mgm/m2, with an annual average of 1465 mgm/m2. The dominant taxon in the OV farm was earthworms, followed by ants, spiders, mole-crickets, adult carabids, Lepidoptera (larvae), and Pyrrhocoridae. At the YV farm, the dominant taxon was ants, followed by mole-crickets, Isopoda, earthworms, Tenebrionidae (adults and larvae), and spiders. Predators were at a relatively low percentage, as regards density and biomass, in both vineyards, if mole-crickets are considered only as grazers. Grazers were of a relatively high biomass in YV.

RESUME

Quelques Aspects des Taxons Importants de la Mésofaune du Sol dans un Désert Côtier Afro-Méditerranéen.

II.-La Mésofauna du Sol dans les Vignobles Irrigués.

Un échantillonnage de la mésofaune du sol de deux vignobles irrigués, dans la dépression au sud de la troisième crête, près du village de Ghaibaniat, à 53 km à l'ouest d'Anlexandriae, a été effectué durant la période 1977—1978. La densité annuelle de la population dans le plus "vieux" des deux (OV), passait de 6 à 112/m2, avec une moyenne annuelle de 46/m2, et dans l'autre (YV), passait de 5 à 196/m2, avec une moyenne de 52/m2. La biomasse (des individues préservés en alcool), passait de 59 à 3 921 mgm/m2, avec une moyenne annuelle de 1 488 mgm/m2, tandis qu'elle passait de 524 a 3 821 mgm/m2, avec une

moyenne annuelle de 1 465 mgm/m2, dans YV. Le taxon dominant dans OV était les vers de terre (*Allolobophora caliginosa* f. *trapezoides*), suivi par les fourmis, les araigneés, les coutilierès (*Gryllotalpa gryllotalpa*), les carabides,(adultes), les lepidoptères (chenilles), et les pyrrhocoridés. Dans YV, le taxon dominant était les fourmis, suivi par les courtilières, les cloportes, les vers de terre, les ténébrionidés (adultes et larves) et les araignées. Les prédateurs (sans compter les courtilières) etaient d'une faible densité et biomasse dans les deux vignobles. mais les taxons nuisibles (y compris les courtilières) étaiant d'une biomasse bien importante dans YV.

REFERENCES

1. AYYAD (M.A) and GHABBOUR (S.I.), 1977.—Systems. Analysis of Medriterranean desert ecosystems of northern Egypt (SAMDENE). *Environ. Conserv.* 4: 91—101.

2. EL-DUWEINI (A.K.) and GHABBOUR (S).I., 1965—Population density and biomass of earthworms in different types of Egyptian soils. *J. appl. Ecol.* 2 : 271—285.

3. GHABBOUR (S.I.) and SHAKIR (S.H.) 1980.—Ecology of soil fauna of Mediterranean desert ecosystems in Egypt. III.—Analysis of *Thymetaea* mesofana populatos at the Mariut frontal plain. *Rev. Ecol. Biosol* 7:327—352.

4. GHABBOUR (S.I). and SHAKIR (S.H.), 1982 a.—Population parameters of soil mesofaune in agro-ecosystems of the Mariut Region, Egypt. I.—Under dry-fermed almond. *Ibid.* 19 : 73—87.

5. GHABBOUR (S·I.) and SHAK IR (S.H·), 1982 b.—Idem. II.—Under dry-farmed fig. *Ibid.* : (in press).

6. GOMAA (A.M.), FATHI (A·M.), ZAHABY (E.M.), MOUKABEL (M.) and NAGUIB (M.)' 1978. —Morphological, chemical and hydrophysical soil characteristics. SAMDENE *Progress Report* No. 4, vol. 3, ch. 5 : 87 pp.

7. KASSAS (M.), 1972.—A brief history of land use in Mareotis Region, Egypt. *Minerva Biol.* 1 : 167—174.

8. KASSAS (M.), 1879.—Mareotis : Past, present and future. In : *Analysis and Management of Mediterranean Desert Ecosystems*, ed. M. KASSAS, Proc. Int'l SAMDENE Workshop, Jan. 1979, Univ. of Alexandria : 24—28.

9. LE FLOC'H (E)., 1981.—Mapping of land occupation. REMDENE *Progress Report* No. 2, vol. 1b, ch. 5 : 20 pp.

10. LONG (G., 1979—Mapping of renewable resources for land development and land use decision with special reference to the western coastal desert of Egypt. In : *Analysis and Management of Mediterranean Desert Ecosystems*, ed. M. KASSAS, Proc. Int.'l SAMDENE Workshop, Jan.1979, Univ. of Alexandria : 37—50.

11. ROBERTS (S.R.) and HSI (B.P.), 1979.—An index of species abundance for use with mosquito survaillance data. *Environ. Entomol.* 8 : 1007—1013.

12. SOLIMAN (G.), 1981.—Rural management and mobillization of labour force at Burg El-Arab. REMDENE *Progress Report* No 2, vol. 1a. ch. 4 : 35 pp.

13. SOLIMAN (M. H.), 1979.—Agriculture in the northwestern coast. Paper presented at : REMDENE *Seminar on Olive*, 6 Sep. 1979., Univ. of Alexandria : 2 pp.(typescript in Arabic).

14. UNDP/FAO, 1971.—*Preinvestment Survey of the Northwestern Coastal Region. United Arab Republic.* ESE : SF/UAR 49, FAO, Rome, Technical Reports 1—6 varying pagination.

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معالم بعض الأقسام الهامة من حيوانات التربة المتوسطة الحجم فى صحراء ساحلية أفرو متوسطية ٢ ـ حيوانات التربة المتوسطة الحجم فى مزارع العنب المروية .

اعـــداد

دكتور ســمير ابراهيم غبور و صفوت هــلال شاكر

قسم الموارد الطبيعية ، معهد البحوث والدراسات الافريقية ، جامعة القاهرة

ملخـــص

أجريت دراسة مسحية لحيوانات التربة المتوسطة الحجم فى مزرعتين من العنب المروى جنوب قرية الغربانيات على بعد ٥٣ كم غرب الاسكندرية فى عامى ١٩٧٧ و ١٩٧٨ . وتقع المزرعتان فى منخفض من تربة جيرية وعمر احداهما حوالى ٧ سنوات وقت الدراسة وكثافة شجيراتها ١٠٣٠ شجيرة للفدان (وقد سميت عنب قديم) وعمر الأخرى ٣ ـ ٤ سنوات وكثافة شجيراتها ٩٣٠ شجيرة فى الفدان (عنب حديث) . وقد تراوحت كثافة حيوانات التربة متوسطة الحجم فى العنب القديم بين ٦ و ١١٣ للمتر المربع بمتوسط سنوى قدره ٤٦/م٢ بينما تراوحت الكثافة فى العنب الحديث بين ٥ و ١٩٦ للمتر الربعوبمتوسط سنوى قدره ٥٢/م٢. أما الوزن الحى (مقدرا بوزن العينات المحفوظة فى الكحول) فقد تراوح فى العنب القديم بين ٥٩ و ٣٩٢١ مجم /م٢ بمتوسط سنوى قدره ١٤٨٨ مجم /م٢ وتراوح فى العنب الحديث بين ٥٢٤ و ٣٨٢١ مجم/م٢ وبمتوسط سنوىقدره ١٤٦٥ مجم/م٢. وكانت الأقسام السائدة فى العنب القديم هى : ديدان الارض ثم يتبعها النمل والعناكب والحفار والكارابيدى وحرشفيات الأجنحة (يرقات) ثم بعض البق النباتى .

أما فى العنب الحديث فقد كانت الأقسام السائدة هى النمل يليهــا الحفارات ومتساويات الأرجل وديدان الأرض والظلاميات ثم العناكب . واذا أعتبرنا الحفارات محرد عواشب فقد كانت نسبة المفترسات منخفضة نسبيا فى كل المزرعتين من حيث الكثافة والوزن وكانت العواشب ذات وزن مرتفع نسبيا فى العنب الحديث .